

CHEMICAL WARFARE MATERIAL AT FORMERLY USED DEFENSE SITES

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1. INTRODUCTION

This paper highlights cleanup efforts under the Defense Environmental Restoration Program at sites contaminated or suspected to be contaminated with chemical warfare materiel. Chemical warfare materiel are munitions or containers holding blister agents, nerve agents, blood agents, and choking agents. Also of concern are soil and scrap contaminated with these agents, or soil contaminated with decontaminating solutions. This paper outlines the history of military use that led to contamination. It also provides an outline of Response Actions including the detailed planning assessment and facilities necessary to support a cleanup.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE AUG 1992		2. REPORT TYPE		3. DATES COVERED 00-00-1992 to 00-00-1992	
4. TITLE AND SUBTITLE Chemical Warfare Material at Formerly Used Defense Sites				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers,Huntsville Division,P.O. Box 1600,Huntsville,AL,35807-4301				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADA260985, Volume II. Minutes of the Twenty-Fifth Explosives Safety Seminar Held in Anaheim, CA on 18-20 August 1992.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 41	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

2. BACKGROUND

2.1 LETHAL CHEMICAL AGENTS

As defined by the U.S. Army lethal chemical agents are those agents that primarily cause death among target personnel. They are limited to choking, nerve, and blood agents.

2.1.1 Choking agents injure an unprotected person primarily in the respiratory tract. They attack the membranes of the nose, throat, and lungs causing swelling. The lungs fill with fluid and death result from lack of oxygen or "dryland drowning". The most common choking agent is Phosgene or (CG). CG is a non-persistent colorless gas that although is of limited solubility in water, decomposes immediately in most field conditions. Used extensively in World War I, CG accounted for more than 80% of the chemical agent fatalities in that war.

2.1.2 Nerve agents inhibit the enzyme acetylcholinesterase which is required for the function of many of the bodies nerves and muscles. The type of attack on the body is dependent on both the dosage and the route of exposure. However, nerve agent may cause the cessation of functioning of skeletal muscles (arms, fingers, etc.), involuntary muscles (heart, lungs), and the central nervous system. The principle nerve agents are of the G-agent and V-agent varieties. G-agents are fluorine or cyanide containing organophosphates. They are a colorless liquid and very non-persistent. G-agents, although a liquid are extremely volatile and have a vapor pressure so high that vapors are lethal. V-agents are sulfur containing organophosphorous compounds. They are a highly persistent, extremely toxic, oily liquid. Human effects of both V and G series nerve agents are primarily the same.

2.1.3 Blood agents are cyanide containing compounds whose primary route of entry into the body is through inhalation. Blood agents prevent cell respiration and the normal transfer of oxygen from the blood to body tissues. The most common blood agents are hydrogen cyanide (AC) and cyanogen chloride (CK). Both are highly volatile and very non-persistent.

2.2 BLISTER AGENTS (VESICANTS)

Although blister agents do cause fatalities, blister agents were also intended for use to restrict the use of terrain, to slow movements, and to hamper the use of materiel and installations. All blister agents are persistent and may be employed in the form of colorless gases and liquids. They damage any tissue that they contact. They affect the eyes, lungs and the skin. They may cause lethalties, primarily through inhalation, but skin damage is their main casualty producing effect. Blister agents, in addition to their designed effects are a long term health hazard because they are known carcinogens.

2.2.1 Mustards are the most common grouping of blister agents. Mustards are divided into two types, sulfur mustards (H and HD) and nitrogen mustards (HN-1, HN-2 and HN-3). During World War I mustard (H) was the only blister agent in major use.

2.2.2 Arsenical vesicants are a group of related compounds in which arsenic is the central atom. The main arsenical vesicants are lewisite (L), mustard-lewisite mixture (HL), and phenyldichloroarsine (PD). Lewisite is the most common and the only one to be addressed in this paper. It produces similar effects as mustard with the exception is that L produces immediate pain.

3. HISTORICAL MEANS OF CONTAMINATION

3.1 GENERAL. The United States is very different from other parts of the world as to the means by which chemical warfare materiel is contaminating the earth and posing a threat to man and the environment. Unlike Europe, Africa, and the Middle East, no battles were fought in the U.S. using chemical agents. Even today, dud fired rounds are found in Europe still containing their chemical payloads. These munitions are left over from World War I battles. In other places, chemical rounds are found from the World War II era. Although not fired in battle they are the results of either battle damage or the intentional destruction techniques used either by the conquering army or by the defenders to prevent the capture of materiels that could be used by the enemy. The contamination in the U.S. is the direct result of the lack of knowledge of environmental effects and the vastness of the country lending to the philosophy that some areas could be contaminated forever and no one would be affected. The thought at the time seems to be that of taking immediate danger to the individual away, thus making burial a common solution to the immediate problem. No thought seems to have been given to the long term effects that these practices wrought.

3.2 Manufacturing and storage were two of the primary initial causes of contamination. In the manufacturing process, some of the techniques used contributed directly to contamination. For instance waste water settling ponds that were covered over or allowed to dry up, today contaminate both soil and ground water with high levels of arsenic used as the base in lewisite manufacturing. Dumping and burying of defective batches was a usual practice. The water and decontaminating solutions used to clean production lines went down drains and was not always collected. In the loading plant both leaking bulk containers and leaking munitions often had their contents dumped in pits dug into the earth, lime was then added and the pit covered. The same is true in storage operations. It would seem that many of the bulk containers and munitions in storage developed leaks because of the reactivity of the chemical agent to metal. Again dumping into a pit with lime was often the solution. Years after manufacturing ceased, the walls of building were found to be permeated with chemical agents, particularly blister agents.

3.3 Disposal operations following World War II contributed the greatest actual amount of contamination. The disposal activities, while involving the greatest volume, were carried out in more controlled situations. They were done on military installation and were done by various methods, approved at the time as safe. Some were, as discussed above, simply opening the munition or container, dumping the agent into a pit and adding some type of decontaminating solution. Finally the pit was covered and a new pit was dug.

3.3.1 In some cases, transfer operations took place such as transferring chemical agent from the munition to a bulk container like the one ton container. Two specific goals drove these operations. The first was the further use of the chemical agent such as the study of captured German nerve agent. Also agents were taken from either obsolete or inefficient munitions and later put in updated configurations. Finally, some chemical agents with industrial uses, such as phosgene, were sold to industry as a basis for fertilizer. The second was the recovery of the metal in the containers and munitions. This appears to be the paramount issue. Studies of many of the old reports of disposal operations detail only sketchy accounts of the disposal of chemical munitions but go into great detail about the amount and sometimes the condition of the metal salvaged.

3.3.2 The method to insure recovered metals were decontaminated was simply burning. Either in the smelting process or after the initial treatment of the chemical agent. This later was done by open burning. Some agent filled

containers were also vented by various methods (mechanical puncture, explosive puncture, or by being shot with a bullet) and open burned. This procedure involved digging a trench, filling the bottom of the trench with flammable materials such as wood to a depth of several feet, placing the munition or container on the flammable material, pouring diesel fuel over the entire trench and igniting. In most cases this was the most effective and left the fewest traces of contamination.

3.3.3 Burial was also an accepted method of disposal. It is not sure whether in some cases this was a sanctioned method or the result of a long day with a desire to take short cuts. Both are probably the case. As human nature would tend to verify the later, old Field Manuals refer to burial as a method of temporary storage. With changes in missions and transfer of personnel, it is likely that these temporary storage points were often forgotten.

3.4 Of all the contamination generating activities, the most frequently arising is in the area of movements. While many leaking munitions and containers were resealed or drained of their contents, which were placed in new and intact containers, many records and reports indicate this was not always the case. Many times the transport crews emptied the chemical warfare agents into pits dug along railroad tracks, dropped the agent container into the pit, threw in lime, and covered the hole over during a rail move. During port operations, bombs and containers were often taken out to sea and dumped. It may have been the intent to return at a future date and remediate or at least check the area, but records show this was done in only a small percentage of cases.

3.4.1 At Enclosure 1 is a typical report of a rail movement incident involving leaking 55 gallon drums. It details the response from the "Guard and Security Division of the Chemical Warfare Center at Edgewood Arsenal, Maryland. This report typifies the kinds of incidents that occurred over an approximate twenty year time frame of chemical warfare agent movements from the early 1940s to the early 1960s. In this case, using this report as a starting point, the Kansas City District of the Corps of Engineers has been able to locate this pit for future testing.

3.4.2 Enclosure 2 is an example of an attempt to investigate a suspect burial pit during a base closure operation. This is the basis for the expanding chemical warfare agent portion of the Huntsville Division of the Corps of Engineers, Design Center and Mandatory Center of Expertise, Ordnance and Explosive Waste five year work plan.

3.4.3 Enclosure 3 are examples of excerpts from typical water transport operations. In some cases, sea dumping was the final destination. In other cases, land burial was done. As is indicated, some of these operation were not totally successful.

3.5 One of the most complex and nagging problems today when dealing with chemical warfare materiel is the "War Gas Identification Set, Detonation, M1 and AN-M1A1," the "War Gas Identification Set, Instructional, and the "M1 Set, Gas, Toxic, M1 and M2". There are three reasons for why these sets create so many problems.

3.5.1 First there are many individuals in both civilian and military aspects of environmental remediation who are under the false belief that these are all diluted "sniff" sets used to familiarize the soldier in what different warfare agents smell like. There are indeed "sniff" sets that were used for this purpose. However there were also sets containing not only "neat" mustard but also a set containing GB nerve agent. Also some sets had Lewisite, a known carcinogen.

3.5.2 The second reason these sets are such a problem is that they were not accounted for. Records indicate how many sets went to what installations. But no records can be found to show what happened to the sets after they arrived at that installation. Because of the amounts of isolated incidents reported over the years from all parts of the country, it appears that a great many of these sets were not expended in training but were simply buried.

3.5.3 The third major problem with these sets is that the basic component is a glass vial. Unlike steel rounds of ordnance, bulk containers, or drums. Glass vials are extremely difficult to locate in the ground. Obviously, magnetometers and metal detectors won't locate glass. Currently being looked at for this purpose is Ground Penetrating Radar. However, this is not yet a proven method. It may be asked "Why bother to look? Glass is not contaminating the earth and the agent isn't leaking." This is true until you realize that these sets are being unearthed either during other Hazardous and Toxic Waste investigation or they are discovered by individuals doing other intrusive work such as installing a fence.

4.0 RESPONSE BY THE ARMY TO RECENT INCIDENTS

4.1 The Former Raritan Arsenal Site along with Former Ft. Segarra in the U.S. Virgin Islands are the politically sensitive issues that caused the U.S. Army to relook the methods of handling non-stockpile and abandoned chemical warfare materiels and to cause the Vice Chief of Staff of the Army on 1 June 1992 to publish policy guidelines in the form of a memorandum to The Assistant Secretary of the Army For Installations, Logistics, and Environment (ASA,ILE), The Commander, U.S. Army Materiel Command, and to The Chief of Engineers. This policy guidance (Enclosure 4) Subject: Restoration of Formerly Used Defense Sites (FUDS) Contaminated with Suspect Chemical Weapons (CW) Materiel, clearly delineates not only the priorities which the Army Staff places on its FUDS remediation, but also individual agency responsibility. It also proscribes funding to be used and breaks down what funds will be expended and where.

4.1.1 The established priorities for FUDS remediation as stated by The Vice Chief of Staff of the Army are Former Raritan Arsenal and Former Ft. Segarra. This is due primarily to the "High level public and governmental attention".

4.1.2 In setting down agency responsibility, the Vice Chief of Staff's Memo states, "The restoration of Raritan Arsenal and Fort Segarra will be carried out under the ASA(ILE) policy guidance. USACE retains on-site management responsibility. Director Space and Special Weapons, DCSOPS will be focal point for integration of chemical surety, safety, and security policy as it applies to this unique operation." In addition the roles and missions of the U.S. Army Chemical Materiel Destruction Agency (USACMDA), Corps of Engineers, and Army Materiel Command are defined.

4.1.3 Although when published, this memorandum was directed at off site movement and storage and not at other alternatives such as on site disposal, the funding requirements are either adequate or can be slightly shifted to be equitable. The memorandum states, "Funding requirements directly attributable to planning, preparation, and execution of restoration and recovery operations will be resourced from Defense Environmental Restoration Program (DERP) funding. Technical Escort Unit support to USACMDA will be on a reimbursable basis. Storage costs will be executed from AMC normal operating accounts."

4.2 In the past the Technical Escort Unit (TEU) has been the sole source of response to chemical warfare materiels (CWM) found either on military installations or on Formerly Used Defense Sites (FUDS). Although the Army has a program in place, the

Chemical Accident or Incident Response and Assistance (CAIRA) Operations were designed for accidents or incidents involving stock pile weapons and containers. Even if these events were to occur off installation, the gearing of the response is to transport of stock pile ordnance.

4.2.1 Recovered or discovered ordnance containing CWM has been the mission of TEU. If ordnance were found either on or off installation, the most common scenario was the closest Army Explosive Ordnance Disposal (EOD) unit was notified. After an inspection by the EOD team, if a CWM munition was suspected, the EOD team would either report the item directly to TEU or would follow the procedures in AR 50-6 which is to report the incident to the Army Operations Center who in turn makes notification through channels to TEU.

4.2.2 A reluctance on the part of EOD to notify TEU was soon formed because the same regulation that explained how to report a found munition also required whoever found it to secure it until relieved by proper authority. The TEU often took time to arrange aircraft, packaging materiel, protective clothing, and personnel transportation. Thus, the individual possessing the ordnance was duty bound to guard it, sometimes for several days.

4.2.3 Upon arrival at the site, TEU would take non intrusive samples (vapor samples), decontaminate if necessary, package and transport to the closest compatible Chemical Surety Storage Facility. This trip was by military aircraft, aircraft and crew, plus TEU personnel were certified under the provisions of AR 50-6. Under section 5.1, Legal Changes, this paper, the reasons for this process being no longer an option will be discussed. Here however, I will say that legal and public opinions have changed in many places making this type of operation less than desirable.

4.3 The U.S. Army Armament, Munitions, and Chemical Command (AMCCOM), which is a subordinate command to the Army Materiel Command (AMC), is the service manager for CWM. This agency along with the DESCOM who manages Army Depots, controls all installations that have a Chemical Surety Mission. In this capacity, AMCCOM was tasked by AR 50-6 to provide the closest surety location for found munitions. Again because of legal problems to be discussed later, AMCCOM had a get deal of difficulty in complying with this mission. For whatever reason, AMCCOM unofficial policy tended to be; for truly accidental finds of CWM, TEU would transport to a Chemical Surety Facility. If however, a CWM removal action or remediation occurred that was planned to include risk assessment, health and safety plans and work plans, it could not be supported by AMCCOM. The catch

phrase was, "Just don't dig". This philosophy was later changed, not from within the Army but through Congressional Pressure brought to bare over Fort Segarra and Raritan Arsenal.

4.4 The first in many cases to feel this political pressure was the Huntsville Division of the Corps of Engineers (CEHND). As the fledgling Mandatory Center of Expertise and Design Center for Ordnance and Explosive Waste, of which CWM is a subset by definition, CEHND manages the Inventory Project Report (INPR) system. Under this system Formerly Used Defense Sites (FUDS) are identified by districts and recommended for remediation projects. It soon became obvious that there was a problem, there was no method in place to deal with suspected CWM contaminated sites. During the last two years, CEHND has gone to numerous Army agencies for a solution to this problem. Between political pressure and several other agencies assistance, several of the legal and technical hurdles were overcome.

4.5 The most relevant and important event was the formation of the office of the Project Manager, Non-Stockpile Chemical Materiel Destruction. At this point in time this office answers directly to the Deputy Assistant Secretary of the Army for Installations, Logistics, and Environment. Eventually it will be a sister agency to the Chemical Demilitarization Program. Both will be under the U.S. Army Chemical Materiel Destruction Agency (USACMDA). This agency was formed on 22 Jun 1992, earlier than originally planned. As stated in the Vice Chiefs memorandum, "USACMDA" will provide overall direction to include resource programming, environmental documentation for transport mode and storage site selection, and the development of equipment and procedures. The USACMDA focus for the time being is on Former Raritan Arsenal and Former Ft. Segarra as directed by the Vice Chief of Staff. USACMDA has started its mission with an extremely ambitious Scope of Work to its current contractor to look at programmatic issues as well as specific issues dealing with the two sites. Some issues being looked at but not all inclusive are transportation, permitting, destination, on site treatment and on site lab capability.

5.0 PLANNING AND ALTERNATIVES

5.1 Legal changes have been constantly forthcoming. Changes and even additions to the Army's view as to how to treat recovered chemical warfare materials have occurred with ever increasing regularity.

5.1.1. As of this date the Office of Army Counsel has formally stated that because it meets the characteristics of the Resources Conservation and Recovery Act (RCRA) Hazardous and Toxic Waste

definition and therefor will be treated under RCRA. Although this is the official position of the Army Counsel, it is widely disagreed with both in the Army and in the civilian sector.

5.1.2 One of the chief reasons behind this position is typically one of self imposed abuse that stems partially from the trial of the "Aberdeen Three". These Department of Army employees have been used as an example to instill dread throughout the Environmental community. At the outset of the ongoing Raritan and Fort Segarra issues, one could not attend a meeting without this trial being brought up and someone fearfully predicting the doom of jail time. There are two points of view without the benefit of information about the "Aberdeen Three". One holds to the belief that these three innocent government employees, while doing their jobs as set forth in the job descriptions and as directed by proper military authorities, were abandoned to face the State of Maryland Regulators without any financial or other help from their employers. In other words, while doing what they were told, they took the fall or blame for the Army. Recently, it was stated that they had each paid over \$80,000 out of their own pockets for their legal defense. Personal liability has been a constant fear ever since the verdict. The second view however, is much different. That opinion states that these three were, unknown to their employers, knowingly and intentionally dumping hazardous chemicals. They further attempted a cover-up and in fact, part of the rumors include misappropriation. The point here is not to rehash what actually happened but to show how the whole issue has become much more than it actually was.

5.1.3 To further complicate the issue of RCRA, previous Commanders at Installations that have a Chemical Surety Mission, cut deals with state regulators so that the states had a definite impact on the operation and the mission of that installation. At no other time in the history of the United States and in no other issue have states been given primacy over military missions and issues. But by capitulating to state regulators by getting Hazardous Waste Storage Permits these former installation commanders have set the precedence that the Army Counsel is following. That is that CWM is HTW and therefor controlled by RCRA. There are three basic problems associated with that position.

5.1.3.1 The first is that many things have the characteristics of HTW and are not specifically addressed by the Army Counsel as HTW. The batteries in a lap top computer have the characteristics of HTW.

5.1.3.2 RCRA, as defined by GAO is used to regulate and control current Hazardous Waste Generators. It is not used for the remediation of sites that have been abandoned. The exception to this is when an installation is characterizing "all" Solid Waste Management Units in conjunction with its application or renewal of its RCRA Part B permit.

5.1.3.3 Finally, RCRA is enforceable by the Environmental Protection Agency and may be delegated to state agencies. However, the removal response authority for Ordnance and Explosive Waste (OEW), of which CWM is a subgroup, lies with the Department of Defense. In turn, this has been further delegated through the Department of the Army and the Chief of Engineers to the Commander of the Huntsville Division of the Corps of Engineers. As the removal authority, and operating under the National Contingency Plan, the Corps of Engineers has operated effectively in environmental remediation of OEW operating under the Comprehensive Environmental Response, Compensation, and Liability Act or CERCLA. Although all RCRA requirements are met, no permits, State, Local, or Federal are required. This becomes the major issue currently affecting the CWM clean-up program. The differences of who is the regulatory authority is only one reason that this issue is a major problem. In the next few paragraphs, some of the stumbling blocks will be reviewed.

5.1.4 While digging a trench for a pipeline at Redstone Arsenal, Al., a contractor unearthed approximately eighteen 4.2 inch mortar rounds and one two pound incendiary bomblet. These were investigated by a team from the Explosive Ordnance Disposal (EOD) Division of the Ordnance Missile and Munitions Center and School (a tenant organization at Redstone Arsenal). The EOD team was able to determine that the rounds were unfuzed and that some contained a liquid filler. As Redstone Arsenal is the site of one of the largest CWM manufacturing, storage and test facilities during World War II, the rounds were immediately suspect of containing CWM. The rounds were placed in double plastic bags. Vapor samples were collected from inside the bags after a wait time for vapors to collect, and the 4.2 inch mortar rounds were evacuated to storage bunker belonging to the EOD Division. The installation environmental office was notified and the two pound incendiary bomblet destroyed at the EOD training range. By the time this entire incident was finished (two years later) because the environmental office listed all recovered items as HTW no Surety Installation would accept them (Surety Installation RCRA permits did not cover HTW). The EOD Division was chastised for unauthorized disposal of Hazardous Waste (their range was a training range). Redstone violated RCRA by storing hazardous waste without a permit. Once an exception was granted and the rounds were taken to Anniston Depot, they had to be stored by

themselves because the compatibility could not be determined, i.e. they could not be sampled without opening their contents to the atmosphere, which is prohibited. Thus we, the Army, however well intentioned have created an administrative gridlock. We have called CWM HTW, then we have tried to apply the standard such as the use of deadly force and security criteria to these rounds as directed by AR 50-6 and AR 190-59. The bottom line here is, because we have painted ourselves into a corner, we can not remediate CWM found either on Formerly Used Defense Sites or on active installation without violating a law or a regulation.

5.1.5 USACMDA's first real roles will be to unlock this gridlock. Whether CERCLA and the NCP or RCRA or both apply, USACMDA is attempting to determine what can be accomplished. The technical skills and abilities are available to find, recover, package, and transport or neutralize on site CWM. But, until the legal issues are resolved, the regulatory authority established, and a place licensed to receive this materiel, remediation cannot begin. The question remains what do you do with a CWM round if you find it, and not violate laws and regulations.

5.1.6 Further, while this legal issue is on the table, the outcome has little to do with the terms of the chemical weapons treaty now in negotiations. In fact it is thought that recovered rounds containing CWM will be counted in the treaty because they may be fully functional weapons. This in itself may significantly affect the legal views, some of which have refused to acknowledge the fact that these are lethal weapons intended to kill. It matters very little that the intent of the person burying a round was to dispose of it, which has been stated as a test for RCRA and HTW. It may still be a fully functional weapon.

5.2 The storage and transport issue aside, other facilities are needed for a successful remediation. The next few paragraphs discuss the current thoughts on remediation techniques that will be employed.

5.2.1 Before intrusive excavation is to begin and after the site is prepared for intrusive work by surveying, geo technical mapping, soil and water sampling, the question of unexpectedly finding an intact weapon must be address. Even if samples show no trace of CWM or break down by products, the possibility of finding an intact round is always present. These suspect sites were not chosen at random. Extensive archive searches and all available information has been gathered in an attempt to insure that some past event points to CWM and that every effort is made to identify and locate these items with records. As already seen, transporting to an existing facility may not be possible.

The proposed solution is to use milvan type containers designed to store hospital waste. These refrigerated containers could be secured and guarded on or near the remediation site. After recovery, surface decontamination and preliminary packaging, the rounds would be placed in these vans. Not only are they ideal for control. They afford an environment that enhances storage. If the munition contains mustard (HD) the refrigerator would successfully freeze it (HD freezes to solid form around 58 degrees F.). For other agents, the cooling would deter expansion of the agent due to heat and be less likely to leak. The round in the refrigerated milvan would then be guarded, not only to the extent required by regulation, but to insure public trust and confidence.

5.2.2 During the actual intrusive work, a prefabricated, portable building will be erected over the remediation site. This type building is big enough to allow use of a backhoe and several workers and would contain vapors that may be released during excavation. Air monitoring and filtration would warn of elevated levels of air contamination and insure no release to the outside. Air monitoring would be done outside the building as a precaution. This facility is intended to contain any vapors and to instill confidence in area residents who have an unrealistic idea of the effects of CWM.

5.3 Although the Army has worked with CWM for years, all operations have been on fixed installations. All FUDS operations don't have that luxury. Therefore, certain items of equipment must be developed. For instance, at present, when samples are taken (soil and water) they are escorted to a surety laboratory by TEU personnel. When analysis has been completed, weeks may have lapsed. When contractors mobilize and are on site, these kinds of delays account for very large amounts of wasted money. On site labs must be available for fast turn around of analytical data. Another area of equipment need is for real time air monitoring. The Army has real-time air monitoring equipment with the ACAMS and MiniCAMS. Two disadvantages are seen here. These systems require spike samples to use for real time comparison. Sample spikes must be escorted to the site by TEU personnel. Also, this equipment is capable of single agent monitoring so several sets must be on each site at all times unless the agent is positively known. Finally, there is no real time monitor capable of monitoring for Lewisite which is arsenical based. There are other equipment issues that have to be addressed as well.

5.3.1 Another issue is whether OSHA standards are acceptable to the Army for working with these CWM agents. This is important for the contractor who is working on site in OSHA approved Level

A Personal Protective Equipment and is not in compliance with Army Standards. It would seem necessary for the Army and OSHA to have identical standards when dealing with CWM. In addition, if the Army standard is the M3 butyl rubber suit, with temperatures ranging from 80 to 100 degrees F. year round at Former Fort Segarra, the stay time would be almost work prohibitive. In order to effectively remediate a site, workers should be able to labor for two to four hours. In that heat, this could only be accomplished with cooling suits which have not been very effective with the M3 suit.

6.0 FORESEEABLE FUTURE EVENTS

6.1 The immediate foreseeable future at Former Raritan Arsenal starts with a surface sweep to begin on or about 1 Sep 1992. This will be done by contractor and will be enhanced by the use of magnetometers to insure that the search crews are able to avoid stepping on any surface OEW. The area has been previously search and some geo physical work done. There has been no evidence of OEW on the surface in the past. However, there is debris, of which some is believed to be connected to CWM activities. This is in the form of containers not likely to be contaminated by agent. These containers will however be treated as 3X, meaning surface decontaminated. All debris will be segregated into two types, 3X and non 3X. These will at a later date either be taken to a Surety Facility or an HTW facility depending on the results of soil and water sampling and swipe samples.

6.1.1 During the surface sweep phase, surveying will take place to identify the exact original boundary of the area. In addition, foliage and surface soil samples will be taken and sent to a Surety Laboratory for analysis. Determination has not yet been made as to whether bore samples need to be taken of the larger trees in the area.

6.1.2 This is the first portion of site characterization. The surface clearance is to be done with the intent to make the area safe for brush clearance. The next phase planned for November 1992 is to clear all vegetation six inches or less in diameter, off the site to facilitate geo-physical work. This work will consist of magnetometer, metal detector, and ground penetrating radar mapping to determine the exact location, dimension and depth of burial trenches. Further soil sampling to a depth of up to ten feet will be done along with shallow ground water monitoring wells. Another test will be to probe near the buried anomalies and collect and analyze gas samples. Finally, the vapor barrier will be constructed and a test trench dug to determine exactly what is in the ground by retrieving a sample.

6.1.3 In conjunction with the above, with investigation results constantly feeding into it, a Remedial Investigation and Feasibility Study (RIFS) there will be conducted. As the results become more clear, decisions will be made that will point to the recommend course of action to take. This may be any number of possibilities or combination there of. For instance, if no contamination is found and buried anomalies are not OEW/CWM, then the decision may be to do nothing. If samples show that other types of contamination are present that are not related to OEW/CWM, then the area will be remediated for HTW. The decision may be to treat on site or to transport to a Surety Facility. Whatever the recommendation, the results will all be forwarded to the level of the Secretary of the Army for a final determination and a Record Of Decision (ROD).

6.2 At the same time that the RI/FS is going on USACMDA will be conducting Environmental and Feasibility studies for a programmatic approach to the final disposition of recovered CWM. This will include many options such as transportation or on site neutralization. Some of the data from Raritan will be used in this study.

6.3 Former Fort Segarra follows closely behind Raritan in the time table. However, there are separate issues that have to be addressed at Fort Segarra. Part of these issues include ownership and responsibility for hurricane debris removal. Assuming these issues can be overcome fairly quickly, Fort Segarra follows each step completed at Raritan by three to six months.

7.0 CONCLUSIONS

7.1 The most important element in this entire effort is the continued close coordination between USACMDA and the Corps of Engineers. As long as both agencies are aggressively pursuing the same goal of successful remediation of sites contaminated with CWM, the process will run smoothly. There is currently an estimate of over 200 sites in the United States and its territories that may be contaminated with CWM. They range in size and complexity from a several thousand acre arsenal to a eight feet in diameter and six feet deep hole in the ground on the Kansas plains. It is obvious that this is a multi-year/multi-billion dollar program.

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Enclosure 1

GUARD AND SECURITY DIVISION
CHEMICAL WARFARE CENTER
Edgewood Arsenal, Maryland

JFG/wcd
30 September 1944

SUBJECT: Report of a Guard and Security Detail.

TO : Personnel Division, OC-CWS, Gravelly Point, Virginia,
(through Post Adjutant, Edgewood Arsenal, Maryland.)

E X T R A C T

* * * * *

3. 0130 19 September 1944. Group #1, with three-hundred (300) pounds of excess baggage consisting of decontamination material, departed Washington National Airport and proceeded by air via Eastern Airlines to St. Louis, Missouri and Transcontinental & Western Airlines from St. Louis, Missouri to Kansas City, Missouri, arriving at 0830 19 September 1944. Group #2 of detail departed Washington National Airport and proceeded by Airlines enroute to Kansas City, Missouri, arriving at 1630 19 September 1944. Upon arrival at destination each group was met by government transportation, from Ft. Leavenworth, Kansas, which took the personnel to Marysville, Kansas. Group #1 stopped at Ft. Leavenworth, on way to Marysville, Kansas, and officer in charge of detail reported to Major Ketzler, Post Adjutant. Group #1 and Group #2 arrived at Marysville, Kansas at 1400 and 2200, respectively, on 19 September 1944.

4. Upon arrival at Marysville, Kansas, officer in charge reported to Union Pacific officials at the station at Marysville, Kansas and also Major Earl Carter, Chemical Officer, 7th Service Command, who was also present. Detail immediately proceeded to the two (2) cars containing the leaking drums, which were located on a "Y" about two (2) miles north of Marysville, Kansas, outside of the freight yards. In all there were three (3) leaking drums (55 gallon) of Mustard (H).

5. As soon as personnel of the detail was dressed in impermeable protective clothing, the cars were opened and entered for inspection, to determine the seriousness of the leakage. Liquid Mustard (H) had dripped through the flooring of the two (2) cars and was found on the bolsters, cross beams, and trucks of both cars. Missouri-Pacific car #47926, a wooden car, was in a more serious condition, but contained only one (1) of the three (3) leaking drums. The two (2) drums, in Union-Pacific car #188940, a steel car, were of a less serious nature. Agent in all three (3) drums had to be destroyed since there was no means available of transferring the Mustard (H) from the leaking drums to other drums. Since more decontamination material was required, Pine Bluff Arsenal, Arkansas was contacted to make the necessary shipment, which

consisted of approximately eight hundred (800) pounds of protective clothing and equipment. Authority for shipment of decontamination material from Pine Bluff Arsenal, Arkansas to Marysville, Kansas was given by Colonel Gillet, Supply Division, OC-CWS, Washington, D. C., who had been notified of the seriousness of the leakage. Shipment of material, from Pine Bluff Arsenal, Arkansas, was made by Railway Express on 19 September 1944. Pending arrival of the decontamination material from Pine Bluff Arsenal, Arkansas, the contents of the two (2) contaminated cars, with the exception of the three (3) leaking drums, were transferred to Southern Railroad car #261588 and Seaboard Airline car #19135, respectively, from Missouri-Pacific and Union-Pacific cars, and braced and packed for shipment to Pine Bluff Arsenal, Arkansas. All drums were checked for possible leakage and contamination during the reloading operation. After the loading had been completed, the leakers were observed more closely and found to be leaking as follows:

a. Drum #179754, in Missouri-Pacific car #47926, had a six (6) to seven (7) inch crack, slightly off center, in the face of the bottom of the drum. liquid Mustard (H) continuously dripped through this crack. Crack is believed to be due to rust and corrosion, the result of out-door storage and lack of paint. All drums in both cars were rusty and had not been painted for quite some time.

b. One (1) drum, #162061 in Union-Pacific car #188940, had a hole or puncture about one-half (1/2) inch long and about two (2) inches below the rim of the head of the drum. Each jolt of the car resulted in the splash of the liquid Mustard (H) through the hole onto the walls and floor of the car. Hole appeared to be the result of careless use of tools such as a wrecking-bar, claw-hammer, or crow-bar.

c. The other drum, #82242 in Union-Pacific car #188940, had a fracture in the welded rim on the bottom of the drum. Such is not uncommon but in this particular instance, weld looked as if it had been faulty for some time. Leak seemed to be the result of too much buffing or filing, immediately after welding. If such be the case, drum could have been leaking slightly at the time of loading at Deseret Chemical Warfare Depot, Tooele, Utah. During the time the detail was reloading the two (2) cars, a section crew from the railroad was digging a hole approximately three (3) miles north of Marysville, Kansas in which the contents of the three (3) leaking drums could be destroyed. Dimensions of the hole were: four (4) feet wide, eight (8) feet long, and six and one half (6 1/2) feet deep. Hole was in accordance with regulations and was dug near Mile Post 116, on railroad property, away from drainage ditches, highways, and points of likely excavation.

6. Detail was ready to destroy and bury the Mustard (H) on 21 September 1944, but decontamination material had not arrived from Pine Bluff Arsenal, Arkansas. A second "gas-train" of forty-five (45) cars of Mustard (h) passed through Marysville, Kansas at 1300 21 September 1944 enroute to Pine Bluff Arsenal, Arkansas, escorted by a Guard and Security Detail under the command of Lt Hoffman, Guard and Security Division. Lt. Hoffman had with him, one-thousand, five-hundred (1,500) pounds of Grade BB Calcium Bleach and fifteen (15) gallons of DANC. This detail, borrowed from Lt.

Hoffman, fifteen (15) gallons of DANC and four-hundred (400) pounds of Calcium Bleach. With this decontamination material the contents of the three (3) leaking drums were destroyed 21 September 1944. It was necessary to use four hundred and fifty (450) pounds of calcium Bleach, two-hundred (200) gallons of water, and ten (10) gallons of DANC in destroying the contents of the three (3) leaking drums. Clearance on the tracks was obtained for one and one-half (1 1/2) hours, while the dumping and destroying operation was being carried out, and no rail traffic was permitted to pass. The three (3) leaking drums, with five-hundred (500) pounds of Calcium Bleach, ten (10) gallons of DANC, necessary tools and other equipment was being carried out, and no rail traffic was permitted to pass. The three (3) leaking drums, with five-hundred (500) pounds of Calcium Bleach, ten (10) gallons of DANC, necessary tools and other equipment was carried up the tracks on a section car, which had a false floor of one (1) by twelve (12) covered with tar-paper, built especially for this purpose. All equipment and the car were set off the track at the hole. Slurry was mixed and the Hoods and Masks were adjusted on all personnel and the destroying operation began. At this time all railroad personnel were six-hundred to eight-hundred (800) yards up wind and only the personnel of the detail were present at the hole where the Mustard (H) was being destroyed. The Mustard (H) and Slurry were poured into the hole simultaneously until all the drums had been drained. Hole was filled with alternate layers of dirt and bleach. Sign was posted, reading "POISON GAS" with the date plainly printed on it. The outside of the drums were then decontaminated, loaded on the flat car and returned to the loaded freight cars. Here, they were once again decontaminated, the leaks or holes sealed with Litharge and Glycerine. The three (3) empty drums, containing the contaminated Sulphur residue, were loaded, packed, braced, and shipped to Pine Bluff Arsenal, Arkansas, for destruction or salvage. The two (2) newly loaded cars, one of which carried the three (3) empty drums, departed Marysville, Kansas 22 September 1944 for Pine Bluff Arsenal Arkansas, with Col. Prince, a member of a Guard and Security detail under the command of Lt. Gower, Guard and Security Division, as security guard. The wood lining of the inside of the two (2) cars was torn out and burned. The lining in the cars that was destroyed was as follows:

a. In the Union-Pacific car #188940, the entire end lining, the siding for one-half (1/2) the length of the car and six (6) feet high, about fifteen (15) feet of flooring on the contaminated end of the car.

b. In the Missouri-Pacific car #47926 the end of the car, which was metal, was decontaminated with DANC, but siding on both sides about two (2) feet high and one-half (1/2) length of car and about twelve (12) feet of flooring were destroyed.

All contaminated metal parts such as the metal ends and sides of the cars, the steel bolsters and cross-beams, the under-carriage and trucks were all decontaminated by use of kerosene and brushes, DANC, and then were finally steamed for about two and one-half (2 1/2), or three (3) hours, and then washed with water. All ground likely to have been contaminated, all tracks

that the cars were on, and all railroad equipment was washed with DANC or covered with Chloride of Lime. A total of six-hundred (600) pounds of Grade BB Calcium Bleach, twenty-five (25) gallons of DANC, ten (10) gallons of kerosene were used for decontamination in addition to the steam and water. The area where agent was buried was checked for odor, but no odor was detected, this being the last thing detail accomplished before departing Marysville, Kansas. The work of decontamination was started 19 September 1944 and was completed at 1200 23 September 1944. There were no casualties or severe burns among, either, military or civilian personnel. All members of the Guard and Security Detail did receive slight vapor burns, which were no more serious than a case of sun-burn.

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/s/ JERRY F CLEASON
/t/ JERRY F CLEASON
2nd Lt., CWS
Guard and Security Division

A CERTIFIED TRUE EXTRACT COPY

U.S. ARMY CHEMICAL CORPS
TECHNICAL ESCORT UNIT (1602)
Army Chemical Center, Maryland

CMLMC-TE-OP (Project Report 140-61)

SUBJECT: Report of Investigation of the Chemical Agent Burial Area at
Raritan Arsenal, Metuchen, New Jersey

I. INTRODUCTION

A. MISSION

To investigate the Chemical Agent Burial Area (Area 5 on the Arsenal map) at Raritan Arsenal, Metuchen, New Jersey (Raritan) to determine if residual contamination exists in the soil.

B. REQUEST FOR INVESTIGATION

Technical Escort Unit services were requested by Lt. Col. H.G. Shade, Executive Officer, U.S. Army Chemical Corps Materiel Command, Army Chemical Center, Maryland, on 26 June 1961.

C. COMPOSITION OF INVESTIGATION TEAM

The Investigation Team consisted of:

James L.E. Hill	1st Lt	077860	OIC
Burnis G. Neal	MSgt	RA34428044	Member

II. EXECUTION

A. GENERAL BACKGROUND

Civilian workers at Raritan who had worked in or around subject area during the time of the burial operations revealed the following information upon being questioned by the Investigation Team:

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SUBJECT: Report of Investigation of the Chemical Agent Burial Area at
Raritan Arsenal, Metuchen, New Jersey

1. During the period 1943-1945 when Raritan was utilized as a shipping port for vessels transporting munitions and equipment overseas, chemical munitions and/or containers which developed leaks were transported to subject area for disposal. Leaking munitions and containers were also transported by barge to Raritan for disposal. The filler for these containers and munitions was, in all cases, mustard (HD). In addition, all containers were of the 55-gal drum type and all munitions were of the 100-lb bomb type.
2. A small detachment of Chemical Corps personnel, assisted by civilians, was assigned the task of disposing of these leakers. The disposal procedure utilized by this detachment consisted of digging a pit 5' by 5' by 5', pouring the liquid mustard out of the munition or container into a decontaminating solution contained in the pit, and then placing the empty containers or bomb casings into the pit. The pit was then covered with earth and signs were posted over it indicating the date of burial, the type of agent buried and a warning against digging in the area. No accurate estimate of the number of pits dug in the area could be obtained.
3. In more recent years, an unknown quantity of potassium cyanide was buried in the area. This compound was buried by the Post Engineers after Raritan ceased utilizing it as a fumigant. The Explosive Ordnance Disposal Squad stationed at Raritan has also, in recent years, utilized a portion of the area in the disposal of red fuming nitric acid by neutralization.

B. INVESTIGATION PROCEDURES

1. The Investigation Team departed Army Chemical Center, Maryland at 270900 June 1961 and arrived Raritan Arsenal, Metuchen, New Jersey at 271320 June 1961. Upon arrival, the Team met with Mr. Louis Jezek, Safety Branch, Office, Chief of Ordnance, Mr. Frank Mish, Ammunition Project Officer, Raritan and Mr. Arnold E. Ohlson, Asst. Safety Director, Raritan. The Investigation Team then accompanied the above-named individuals on a reconnaissance of the subject area in addition to other area suspected of being contaminated with explosives and/or munition components.

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Following the reconnaissance, arrangements were made with the Post Engineers to procure necessary equipment for investigation of the burial area.

2. The area in question is a triangularly shaped section of level terrain which covers approximately 450,00 square feet. It is overgrown with vegetation ranging in height from two to six feet. Soil within the area is sandy with small pieces of gravel interspersed throughout. ~~Test holes dug at various locations in the area established the water table at five feet.~~ A portion of the area approximately 50 by 70 yards is bordered by blank, metal sign posts driven into the ground.
3. At 0830 hours, 29 June 1961, the Investigation Team began its investigation in the area. Initially, probing and excavation was attempted in portions of the area situated outside of the smaller area bordered by sign posts. These operations failed to uncover any evidence of contamination or old burial pits. At this point, Mr. Alvin Larson, Surveillance Inspector who had worked in the area during the burial operations, appeared on the scene and pointed out specific points within the sign post bordered area where burial pits had been dug. Five areas, each approximately 25 feet square, were selected for excavation after probing had indicated solid objects were present beneath the surface of the ground. Employing a bull-dozer with a back hoe attachment, the five selected areas were excavated to a depth of three feet. At this point, a post hole digger and a shovel were utilized in order that the bull-dozer would not become grossly contaminated in the event the chemical agent was still actively present in the bottom of the pit. Further excavation to a depth of four feet in each of the pits uncovered traces of a white substance which appeared to be bleach or lime. Also, the distinctive odor of mustard could be detected in each excavated pit and downwind approximately ten yards from the area in question.

Location Key (Continued)

GCWD	Gulf Chemical Warfare Depot - Huntsville, Alabama
GUAM	Anderson Air Force Base - Guam
HAAP	Hawthorne Army Ammunition Plant - Nevada
JA	Johnston Atoll
KEY	Keyport Naval Torpedo Station - Washington
LALM	Los Alamitos Naval Air Station - California
LEDA	Lexington-Blue Grass Depot Activity
LEJ	Camp Lejeune - North Carolina
LLL	Lualualei Naval Magazine - Hawaii
LOD	Letterkenny Ordnance Depot - Pennsylvania
LRAFB	Little Rock Air Force Base - Arkansas
MAAB	MacDill Army Air Base - Tampa, Florida
MAAP	McAlester Army Ammunition Plant - Oklahoma
MAFB	Maquire Air Force Base - New Jersey
MAP	Mukilteo Ammunition Pier - Mukilteo, Washington
MCMA	Mineral County Municipal Airport - Nevada
MMA	McAlester Municipal Airport - Oklahoma
NAAP	Newport Army Ammunition Plant - Newport, Indiana
NAVG	Naval Magazine - Guam
NAZ	Navajo Army Depot - Arizona
NMD	Naval Mine Depot - Yorktown, Virginia
NOPE	New Orleans Port of Entry - Braithwaite, Louisiana
NRAF	New River Marine Corps Air Field - North Carolina
OKC	Chibana Army Depot - Chibana, Okinawa

CMLMC-TE-OP (Project Report 140-61)

SUBJECT: Report of Investigation of the Chemical Agent Burial Area at
Raritan Arsenal, Metuchen, New Jersey

D. DISCUSSION

As a result of the findings listed in paragraph C above, the following conclusions may be drawn:

1. Vestiges of the mustard buried during the period 1943-1945 still exist in the soil in an active condition at a depth of four and one-half feet. Although soil samples taken at one foot did not yield a positive test with the Chemical Agent Detector Kit, this does not constitute a clearance for soil at this depth. A chemical analysis of this soil would have to be made before this fact could be established.
2. The distinct possibility also exists that, as a result of the agent buried at depths at and below the present water table, traces of the agent may have migrated throughout and even beyond the boundaries of the burial area.
3. The problem of contamination resulting from the burial of potassium cyanide cannot be accurately evaluated since no traces of this compound were knowingly uncovered and no information was available on the exact place or depth of burial, type of containers, or total amount buried.
4. The probability of contamination resulting from the disposal of red fuming nitric acid is considered very small. Two reasons exist for this belief. One, discussions with personnel assigned to the Explosive Ordnance Disposal Squad who participated in the acid disposal strongly indicate that adequate procedures were utilized which should have insured the complete neutralization of the acid. Secondly, even if some of the acid had not been neutralized at the time of disposal, repeated dilution with natural water in the soil during the passage of time would have rendered it relatively harmless.

CHLMC-TE-OP (Project Report 140-61)

SUBJECT: Report of Investigation of the Chemical Agent Burial Area
Daritan Arsenal, Metuchen, New Jersey

E. RECOMMENDATIONS

The question now arises - what can be done to protect personnel from the contamination in the area? Two possible solutions exist.

1. Procedures have been developed whereby trained and properly equipped personnel of the Technical Escort Unit can decontaminate areas of this nature. However, due to the depth of the burial pits, the water which would be encountered upon excavation and the extensive overgrowth of vegetation, the operation would involve considerable expense and the expenditure of much time and effort.
2. The area could be enclosed by a high barbed wire fence and posted in accordance with paragraph 229, TM 3-250. Although this method does not eliminate the existing contamination in the soil, it will - if its warnings are heeded - prevent personnel from being exposed.

s/JAMES L.E. HILL
1st Lt Cml C
Investigating Officer

Enclosure 3

Location Key

ACY	American Cyanamid Chemical Company - Azusa, California
ANAD	Anniston Army Depot - Anniston, Alabama
BAAB	Brooksville Army Air Base - Brooksville, Florida
BARB	Barbers Point Naval Air Station, Hawaii
BHOD	Black Hills Ordnance Depot - Igloo, South Dakota
BRAG	Ft. Bragg - North Carolina
CAAA	Crane Army Ammunition Activity - Indiana
CAAF	Campbell Army Air Field - Kentucky
CHAS	Charleston Naval Weapons Station - South Carolina
CNAD	Crane Naval Ammunition Depot - Crane, Indiana
CON	Naval Weapons Station - Concord, California
CZ	Canal Zone Tropical Test Areas
Deseret	Deseret Chemical Warfare Depot - Utah
DOW	Dow Chemical Company - Pittsburg, California
DPG	Dugway Proving Ground - Utah
EA	Edgewood Arsenal - Maryland
ELM	Elmendorf Air Force Base - Alaska
ENJ	Colts Neck Naval Pier - Earle, New Jersey
FALL	Fallon Naval Air Station - Nevada
FCA	Fort Churchill - Rivers, Manitoba, Canada
FMC	Fort McClellan - Alabama
FTR	Ft. Richardson - Alaska
FTST	Ft. Stewart - Georgia
GAAF	Godman Army Air Field - Ft. Knox, Kentucky
GAK	Ft. Greely - Alaska

Location Key (Continued)

GCWD	Gulf Chemical Warfare Depot - Huntsville, Alabama
GUAM	Anderson Air Force Base - Guam
HAAP	Hawthorne Army Ammunition Plant - Nevada
JA	Johnston Atoll
KEY	Keyport Naval Torpedo Station - Washington
LALM	Los Alamitos Naval Air Station - California
LEDA	Lexington-Blue Grass Depot Activity
LEJ	Camp Lejeune - North Carolina
LLL	Lualualei Naval Magazine - Hawaii
LOD	Letterkenny Ordnance Depot - Pennsylvania
LRAFB	Little Rock Air Force Base - Arkansas
MAAB	MacDill Army Air Base - Tampa, Florida
MAAP	McAlester Army Ammunition Plant - Oklahoma
MAFB	Maquire Air Force Base - New Jersey
MAP	Mukilteo Ammunition Pier - Mukilteo, Washington
MCMA	Mineral County Municipal Airport - Nevada
MMA	McAlester Municipal Airport - Oklahoma
NAAP	Newport Army Ammunition Plant - Newport, Indiana
NAVG	Naval Magazine - Guam
NAZ	Navajo Army Depot - Arizona
NMD	Naval Mine Depot - Yorktown, Virginia
NOPE	New Orleans Port of Entry - Braithwaite, Louisiana
NRAF	New River Marine Corps Air Field - North Carolina
OKC	Chibana Army Depot - Chibana, Okinawa

Location Key (Continued)

PAAF	Phillips Army Air Field - Aberdeen Proving Ground, Maryland
PAFB	Pope Air Force Base - North Carolina
PBA	Pine Bluff Arsenal - Arkansas
PNMA	Pendleton Municipal Airport - Washington
PUDA	Pueblo Depot Activity - Pueblo, Colorado
QUAN	Quantico Marine Corps Air Field - Virginia
RAH	Rahway Arsenal - Rahway, NJ
RMA	Rocky Mountain Arsenal - Colorado
SBSB	Small Boat Wet Storage Basin - Charleston, South Carolina
SBCA	Seal Beach Naval Weapons Station - California
SJOD	San Jacinto Ordnance Depot - Houston, Texas
SUF	Suffield Test Center - Ralston, Alberta, Canada
SUN	Sunny Point Naval Pier - Sunny Point, North Carolina
SVOD	Savanna Ordnance Depot - Savanna, Illinois
TAFB	Travis Air Force Base - California
TEAD	Tooele Army Depot - Tooele, Utah
TNM	Theodore Naval Magazine - Mobile, Alabama
TORO	El Toro Marine Corps Air Station - California
TUL	Tulalip Backup Storage Depot - Tulalip, Washington
UKMR	Upper Kipapa Military Reservation - Hawaii
UMDA	Umatilla Depot Activity - Hermiston, Oregon
WAAF	Wainwright Army Air Field - Ft. Wainwright, Alaska
WHID	Whidbey Island Naval Air Station - Washington
WRAF	Wright Army Air Field - Georgia
YTS	Yuma Test Station - Yuma, Arizona

Incident Summarization Sheets

1. (Date: Jul/Aug 47, Ref: 1947, page 1) One 4.2 inch phosgene (CG) filled mortar cartridge was discovered leaking while unloading on the dock. The item was destroyed by immersing it in a decontaminating chemical solution until all the phosgene had been chemically reacted. Then the item was removed for explosive demolition. There were no injuries.
2. (Date: Mar 48, Ref: 1948, page 1) Minor valve leaks were discovered during the movement on two bulk containers of mustard (H). The leaks were sealed and decontaminated. There were no injuries.
3. (Date: Feb 48, Ref: 1948, page 1) A switching accident at Pine Bluff Arsenal resulted in two railcars filled with HT ton containers derailing and overturning. No leakers occurred and there were no injuries.
4. (Date: Jul 47/Jan 48, Ref: 1947, page 1) One minor road accident. No injuries and no leakers.
5. (Date: Aug/Sep 49, Ref: 1949, page 3) Truck 3 of the convoy was involved in a slow-speed collision with a civilian automobile near Jefferson City, Missouri. No leaks, spills or injuries were involved.
6. (Date: Nov 49, Ref: 1949, page 4) Truck 9 of the convoy was involved in a serious (20 mph) accident with a civilian truck when the police escort in St. Josephs City, Missouri failed to block off an intersection. There were no spills or leaks. Personnel on the truck were injured by the collision (injured neck and back, bruised knee, bruised side, etc.).
7. (Date: Oct 49, Ref: 1949, page 4) During unloading of the trucks, the fact that one 75mm projectile had rolled out of its pallet went unnoticed. The projectile was found later in the day still in the truck at the Ringsby Transportation Company Garage, Denver, Colorado. The projectile was reported to the Army and removed to Rocky Mountain Arsenal without further incident.
8. (Date: Oct 49, Ref: 1949, page 3) The air brakes on truck 8 of the convoy failed causing it to rear-end truck 7 near Bennett, Colorado. A vehicle fire started as the collision was serious, but was quickly extinguished by the escort personnel. There was no leak or spill, but there were some collision oriented injuries.
- 9 (A). (Date: Nov/Dec 48, Ref: 1948, page 2) During placement of the ton containers in the hold of the vessel prior to sea dump, a valve was accidentally sheared off. A vapor leak occurred but was sealed and decontaminated. There were no injuries.
- 9 (B). (Date: Nov/Dec 48, Ref: 1948, page 2) During the sea dump, the scuttling crew reported donning masks due to vapor in the hold of the vessel. It is probable that a ton container leaked during movement to the dump site. There were no injuries.

10. (Date: Jun 50, Ref: 1950, page 2) Truck 303 of the convoy was involved in a collision in Red Bird, Wyoming on 8 June 1950. No further details regarding this accident exist in the historical files.
11. (Date: Jun/Jul 50, Ref: 1950, page 2) Upon starting from a dead stop, a tractor and trailer uncoupled causing the trailer to fall forward onto the ground. There was no damage to the load. There were no spills, leaks or injuries.
12. (Date: Sep 46, Ref: 1946, page 10) Three leaking lewisite bombs were discovered during movement from the train to the barge. These were sealed and decontaminated, and then overpacked. There were no injuries.
13. (Date: Aug 46, Ref: 1946, page 9) Mustard bombs were discovered leaking during the unloading of the barge. The leaking bombs were sea dumped with the other bombs and the spill was chemically decontaminated by a team dressed in protective clothing. One Non-Commissioned Officer was injured. Hospitalization was not required.
14. (Date: Aug 46, Ref: 1946, page 9) Leaking chemical munitions were found during the unloading of the S.S. Richardson. They were segregated onto special barges after being sealed and decontaminated. The leakers included 2 German GA bombs, 2 British H land mines, 46 CG bombs and 154 German H bombs. During the handling of these items "three civilian employees of this station received mustard gas injuries in handling contaminated lines to barges containing leaking munitions. None were hospitalized. Eight enlisted personnel received injuries from mustard gas in miscellaneous operations handling leakers. None were hospitalized." The barges were being used to remove unserviceable munitions found on the S.S. Richardson to a sea dumping area.
15. (Date: May/Jun 46, Ref: 1946, page 5) "Hold Number 2 had a considerable concentration of CG from leaking bombs." The hold was ventilated using large fans. The leakers were sealed. The cargo was unloaded by 18 June 1946. There were no injuries.
16. (Date: May/Jun 46, Ref: 1946, page 5) When unloading of the vessel began, personnel were not in protective clothing and leakers were soon encountered resulting in injuries. Both civilian stevedores and military personnel were then put into full rubber protective clothing. Eventually a total of 2 leaking GA bombs and 154 leaking mustard munitions were discovered. The leakers were sealed, decontaminated and overpacked. They were then segregated on the dock for sea dump. "Fifty-two civilians of the Charleston Stevedoring Company were treated for gas injuries, and 10 of them were hospitalized. Nine civilian employees of the Basin were treated for gas injuries and 3 were hospitalized. Eight Army personnel were injured, and 3 of them were hospitalized." All injuries were mustard burns.
17. (Date: Jul 46, Ref: 1946, page 9) Leaking mustard bombs from the cargo hold of the S.S. Francis Lee were taken by barge to Horn Island, Mississippi, and were open air burned. "All working personnel received vapor burns in the wrist area...some men also had slight burns on the neck." These injuries were incurred by the military group which off-loaded and burned the bombs.

18. (Date: Jul 46, Ref: 1946, page 8) The famous "Leaking Nazi War Gas Train." Soon after leaving Theodore Naval Magazine (12 July 1946) leaking German H bombs were discovered in one railcar. This car was detached from the train at Panola, Alabama, the leaks sealed and the car was returned to TNM for inspection and later shipment.

At Amory, Mississippi, a second car was discovered to be leaking seriously (13 July 1946). It was detached and moved to a siding in Bigbee, Mississippi and was left under guard. In spite of this, several railroad employees of the Amory yard ventured too close to the car and received vapor burns. A military escort team from Edgewood Arsenal arrived and by 17 July 1946, had isolated the leaker, decontaminated the area and destroyed the munition. The railcar then was forwarded to Pine Bluff Arsenal without further incident on 21 July 1946.

Meanwhile, the train with the remaining 8 cars had continued on toward Pine Bluff Arsenal. Arriving at the yard in Memphis, Tennessee (late on 13 July 1946), it was discovered that 3 more cars had leakers on board, and that one was very serious. The train had, in fact, contaminated 10 miles of track leading to the yard. Another special escort team from Edgewood Arsenal was sent to Memphis. The tracks were decontaminated, the leaking railcars were separated and decontaminated, and the leaking munitions were isolated and destroyed. These 3 railcars eventually reached Pine Bluff Arsenal on 30 July 1946.

During the Amory and Memphis operations, at least 21 civilian railyard workers received vapor burns from mustard and 2 were hospitalized. At least twenty-five military personnel received both vapor and liquid burns and at least 4 were hospitalized. The final medical report on these incidents lists 60 total gas exposures - 28 at Amory and 32 at Memphis. The injuries were mainly due to the high summer temperatures, poor availability of proper protective clothing and a lack of understanding and cooperation by local military authorities. This incident resulted in the virtual rewriting of chemical movement procedures used at that time.

19A. (Date: May-Jul 46, Ref: 1946, page 5) This ship, the S.S. Francis Lee, like others carrying captured German stocks, was found to contain leakers; however, this ship contained far more leakers than any of the others. These were segregated on the pier after decontamination and were placed on a barge for disposal (see Incident 17). During the unloading of the vessel 375 people were injured by exposure to mustard, and at least 22 people were hospitalized, making this the worst chemical incident the Army has ever incurred during transportation (excluding combat action during World War II). All of the injured were military personnel, or civilian contract personnel to the Army, principally stevedores.

19B. (Date: Jul-Aug 46, Ref: 1946, page 9) Upon opening the last hold of the Francis Lee, the situation was determined to be beyond handling with the resources at TNM. Consequently, the hold was sealed and the ship was moved to Edgewood, Maryland. Here, technical teams off-loaded the last 300 bombs, destroyed them and completely decontaminated the ship. There were 52 cases of minor vapor burns during this operation, and some personnel were briefly hospitalized. The ship was subsequently moved to Baltimore for "moth balling" prior to being placed in long-term storage. During the moth-balling process, three civilians were injured and hospitalized due to contamination which had

gone undiscovered in a remote portion of the bilge. This area was decontaminated by teams from Edgewood. The ship was checked periodically at its naval reserve mooring for the next 3 years, and no further contamination was found.

20. (Date: May/Jun 46, Ref: 1946, page 4) This ship, the S.S. Isaac Wise, contained some leakers. These were destroyed at San Jacinto Ordnance Depot. Five men received mustard vapor burns during the unloading operation - one ship's crewman, three stevedores, and one military escort person.

21. (Date: Jun/Jul 46, Ref: 1946, page 8) A serious mustard leaker was discovered as the train approached Chattanooga, Tennessee. The car was isolated at Tinner, Tennessee. The leaking bomb was sealed and decontaminated, and mustard which had spilled onto the siding was also decontaminated.

22. (Date: Jun/Jul 46, Ref: 1946, page 8) A leaking railcar was discovered upon entering the Georgia Railroad Yard at the corner of Delta and DeKalb Streets, Atlanta, Georgia. The car was isolated and a military escort team from Edgewood Arsenal was sent to decontaminate the area. The siding was decontaminated and the bomb was isolated and destroyed. Some military personnel on the escort team received minor vapor burns, and one air force enlisted man was briefly hospitalized with vapor burns. During this incident civilians in the vicinity of the leak repeatedly refused to be evacuated. Fortunately, the leak was rapidly contained and no civilians were injured.

23. (Date: Jun 46, Ref: 1946, page 7) One railcar was found to contain leaking drums of mustard upon arrival at Gulf Chemical Warfare Depot. The leaking drums were immediately transferred into sound one-ton containers and the drums were decontaminated. There were no injuries.

24. (Date: Apr 46, Ref: 1946, page 3) On 8 April 1946, while at sea, a ton container of chlorine began leaking through a faulty fusible plug. After unsuccessful efforts to plug the leak, the ton container was thrown overboard. There were no injuries.

25. (Date: Mar 46, Ref: 1946, page 2) On 6 March 1946, while at sea, a 150 pound cylinder of chlorine was found to be leaking. After unsuccessful efforts to plug the leak it was thrown overboard. There were no injuries.

26. (Date: Apr/May 46, Ref: 1946, page 4) Eight 1,000 pound phosgene (CG) bombs and six 500 pound phosgene (CG) bombs were discovered leaking during unloading of the S.S. Park Benjamin. Twelve were repaired and two were destroyed (see Incident 39). There were no injuries.

27. (Date: Mar 46, Ref: 1946, page 2) Two mustard bombs were found to be leaking upon arrival. These were placed on a barge and dumped at sea. There were no injuries.

28. (Date: Feb 46, Ref: 1946, page 2) A gasoline line broke causing the truck to catch fire near Little Rock, Arkansas. The crew quickly extinguished the fire. There were no spills, leaks or injuries.

29. (Date: Jun 46, Ref: 1946, page 7) A railcar was discovered leaking mustard near Manchester, Georgia. Military escort teams were sent from Edgewood Arsenal, Maryland, to decontaminate the spill and arrived on 25 June 1946. The teams located a leaking bomb on 26 June 1946 and decontaminated it. The railcar was then forwarded to Gulf Chemical Warfare Depot (GCWD) without further incident. During the decontamination operations at Manchester, approximately 6 civilian employees of GCWD received mustard vapor burns. Approximately 14 members of the military escort teams also received vapor burns, and 7 men were hospitalized for approximately 2 weeks.

30. (Date: May 68, Ref: 1968, page 2) During the movement of this train from ANAD to Earle, New Jersey, the train was required to be repositioned while in the Potomac River Railroad Yard, Alexandria, Virginia. During this time two carloads of rockets were uncoupled from the train, and upon departure, were inadvertently left in the yard. When this was discovered, a military team was sent to secure them, and they were subsequently moved to the sea dump area without incident. The rockets in the carloads were completely encased in concrete for the sea dump, and at no time leaked or caused injuries.

31. (Date: Mar 58, Ref: 1958, page 1) Leakers developed during the move as follows: 7 discovered in Elko, Nevada, 23 discovered in Portola, California, 34 discovered in Sacramento, California, and 59 discovered upon arrival in Concord. This resulted in 7 of the 15 gondola cars being contaminated. Load was decontaminated enroute and on arrival. No injuries.

32. (Date: Mar/Apr 58, Ref: 1958, page 1) Leakers developed during the move as follows: several minor leaks discovered in Portola, California, major leaks were apparent by the time the train arrived in Sacramento, California. During off-loading in Concord, about 150 leakers were found in 22 of 30 gondolas. Prompt decontamination and temperatures dipping into the 30's at night prevented a major spill. Spills were confined to the gondolas and were decontaminated. There were no injuries.

33. (Date: Apr 58, Ref: 1958, page 1) Leakers developed during the move. During off-loading, leakers were found in 29 of 30 cars. Prompt decontamination prevented a major spill and spills were confined to the gondolas. Leakers were segregated and rapidly overpacked in propellant charge cans during the off-loading at Concord, and all rail cars were decontaminated. There were no injuries.

34. (Date: Sep 65, Ref: 1965, page 4) The VX spray tank being returned was almost, but not quite, empty. During the movement, the spray tank nozzle leaked a small amount of VX. The military escort team used a powdered and spray decontaminant to clean the spill, and the chemical reaction caused a small on-board fire on the aircraft. The fire was quickly extinguished and there were no injuries.

35. (Date: May 65, Ref: 1965, page 3) During Operation YBF as the USNS McGraw was moving out of San Francisco harbor, another ship turned across its bow resulting in a near collision. The ships cleared each other by approximately 600 feet.

36. (Date: Oct 68, Ref: 1968, page 5) Upon preparing to unload one railcar at Umatilla, the rabbits were found dead. Further inspection disclosed a small leak in an MC-1 bomb (GB) at the edge of the center suspension lug. The bomb was immediately taped to stop the leak and was then overpacked. The area was then decontaminated. There were no injuries.
37. (Date: Sep 68, Ref: 1968, page 4) During unloading of one railcar at Umatilla, a leaking MC-1 bomb (GB) was detected. The leaker was taped and overpacked. The area was then decontaminated. There were no injuries.
38. (Date: Aug 64, Ref: 1964, page 2) During the movement to sea, a ton container of mustard leaked at the valve assembly. The lip of the ton container had filled with mustard and the ton container below was contaminated as well. The team evacuated the barge, suited up in protective clothing and returned to the barge. They then dumped both ton containers over the side and decontaminated the spill on the barge deck. There were no injuries and the rest of the material was sea dumped without further incident.
39. (Date: May 46, Ref: 1946, page 6) Three leaking German phosgene bombs were disposed of by taking them offshore and dumping them in deep water. There were no injuries.
40. (Date: Jul 46, Ref: 1946, page 9) During unloading of the Francis Lee, 33 leaking German bombs were set aside on a barge for sea disposal. These were dumped on 13 Jul 46 20 miles off the coast. While dumping the bombs, a forklift pierced one bomb accidentally, contaminating the barge and allowing the mustard to partially drain. Since the personnel conducting the dump were in protective clothing, there were no serious injuries and the barge was decontaminated. However, the partially drained bomb floated away rather than sinking. It subsequently washed ashore (20 Jul 46) where local residents retrieved it as a war souvenir. The Army recovered the item on 23 Jul 46. Fortunately, the mustard had been flushed from the bomb, broken up by wave action, and had reacted with the seawater. The bomb was completely clean of mustard. There were no injuries to the civilians who retrieved the bomb.
41. (Date: Aug 71, Ref: 1970-1977, page 1) During the loading of the USNS Sealift, one pallet of 15 M55 rockets was accidentally dropped approximately 40 feet into the hold of the vessel from a crane. Although subsequent examination showed that some of the rockets had been severely damaged, no spill occurred, and there was no harm to operators or the general public.
42. (Date: Aug 77, Ref: 1970-1977, page 2) Prior to Army inspection, and prior to arrival in the North Area of Tooele Army Depot, one of two engines scheduled to pull the munitions train was involved in a collision when its brakes failed allowing it to roll into another train. Although no weapons were involved in this crash whatsoever, the event was widely covered by the media, so it is mentioned here for clarification. No chemicals were involved in or spilled during this accident. The engine was replaced, and the actual movement operation proceeded without incident.

Enclosure 4



DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF STAFF
WASHINGTON, D.C. 20310

1 JUN 1992

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY FOR
INSTALLATIONS, LOGISTICS, AND
ENVIRONMENT
COMMANDER, U.S. ARMY MATERIEL COMMAND
CHIEF OF ENGINEERS

SUBJECT: Restoration of Formerly Used Defense Sites (FUDS)
Contaminated with Suspect Chemical Weapons (CW) Materiel

1. High level public and governmental attention to the restoration of Raritan Arsenal, NJ and Fort Segarra, VI make it mandatory that we accelerate actions for the recovery of suspect chemical warfare materiel from them. The U.S. Army Chemical Material Destruction Agency (USACMDA) is being formed to accomplish overall programmatic planning and prioritization of effort to clear the estimated 200 formerly used defense sites (FUDS) which also may have suspect CW materiel contamination. USACMDA is designated as the lead agency for recovery of CW materiel from Raritan Arsenal and Fort Segarra. Corps of Engineers and AMC will provide support in the execution of operations to clear these specific sites.

2. Due to the urgency, Raritan Arsenal and Fort Segarra will be pilot projects and planning will proceed as rapidly as possible. Raritan Arsenal will have first priority. On-site activity at Raritan Arsenal will begin as soon as it can be arranged. AMC will provide five borrowed civilian/military personnel as augmentation for USACMDA to facilitate start of planning, pending the hire of permanent personnel. Target job description and grade structure are shown at Enclosure. Specific skills and grade will be worked out between USACMDA and AMC.

3. The restoration of Raritan Arsenal and Fort Segarra will be carried out under ASA(IL&E) policy guidance. USACE retains on-site management responsibility. Director Space and Special Weapons,

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ODCSOPS will be focal point for integration of chemical surety, safety, and security policy as it applies to this unique operation.

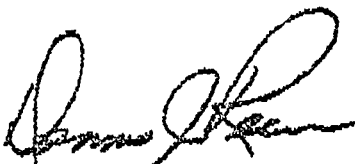
4. USACMDA will provide overall direction to include resource programming, environmental documentation for transport mode and storage site selection, and the development of equipment and procedures. USACE and AMC support responsibility for Raritan Arsenal and Fort Segarra are assigned as outlined below. Working relationships with USACMDA on a broader scale to address the total restoration mission will be established when the agency becomes fully operational.

a. Corps of Engineers: Responsible for all aspects of site restoration operations to include site investigation, site safety documentation, environmental documentation, remediation actions and unearthing of suspect chemical warfare materials. Responsibility for CW materiel ends when materiel is unearthed.

b. Army Materiel Command: Responsible in accordance with USACMDA planning for execution of recovery of suspect chemical warfare materiel once unearthed.

5. Funding requirements directly attributable to planning, preparation, and execution of restoration and recovery operations will be resourced from Defense Environmental Restoration Program (DERP) funding. Technical Escort Unit support to USACMDA will be on a reimbursable basis. Storage costs will be executed from AMC normal operating accounts.

Enclosure


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Vice Chief of Staff